The Brush Control Problem in California[1]

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THE brush problem in California has been "pin-pointed" as one of lost acres—once productive acres now lost to invading brush. Because the brush has increased in abundance, the production capacity of many lands has gone downward. The problem now is to control the brush, to recover the "lost acres" if possible, to prevent further loss, and to keep all acres productive and healthy.

It is needless to say that acres lost to brush are not producing their optimum in domestic livestock, game, timber, recreation and water. The problem of brush control in California is becoming more important all the time because the human population is increasing rapidly. Each day there are more than a thousand new people to house, feed, clothe, to use water, and to demand recreation facilities in one form or another. Furthermore, the population is expected to increase at this pace for some time. In view of this, it is not wise to permit the continual loss of productive acres to brush.

It is gratifying to report that a number of agencies and organizations in California are now cooperating in research on the many fundamental and practical aspects of the brush control problem. Among these are the California Department of Fish and Game, the U. S. Forest Service, the State Division of Forestry, and several departments of the University. Ranchers are contributing greatly. The Agricultural Extension Service and organizations like the San Francisco Chamber of Commerce are participating by carrying information to the general public. The very fact that all of these agencies and organizations are working on the brush control problem indicates great progress in itself. In California, probably more than in many other areas, the brush problem greatly concerns not only the livestock industry, but other groups like sportsmen, farmers using water for irrigation, foresters and outdoor recreationists. Brush control is a problem on many wild lands used for purposes other than grazing. Furthermore, it is a problem on public lands as well as on private lands. For the past six years the California Department of Fish and Game and the University of California have studied the "Effects of Brush Removal on Game Ranges in California." This is done under Federal Aid in Wildlife Restoration Act, Pittman-Robertson Research Project 31-R. The report here is taken largely from this study.

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Brush Types

The brush in California west of the Sierra crest is often referred to as chaparral. This term is derived from the Spanish word "chaparra" meaning scrub oak. This term was applied by the early explorers of California to the low, shrubby, dominantly evergreen vegetation which they found to be so characteristic of the coast ranges and the foothills of the Sierra. Actually, the chaparral includes many species. The most important features are the deep root systems, the dense rigid branching, and the small, thick, heavily-cutinized, evergreen leaves. The chaparral is characteristic of California west of the Sierra crest and the deserts; in other words, of the region of the "Californian" climate (Cooper, 1922). This is a Mediterranean-type climate with wet, mild winters and long, hot, dry summers. From May to September there may be no rainfall except for thunder showers in the mountains. During this period, maximum temperatures are frequently above 105° F. and the relative humidity may become as low as 5 to 8 percent. During the long summer period the vegetation becomes extremely dry.

It is interesting to note that this type of climate is characteristic of four other regions of the world: the Mediterranean region itself, parts of southern and western Australia, South Africa and Chile (Whyte, 1949). Shrubs seem to do well in this kind of climate because of their deep root systems and sclerophyllous leaves. Perennial grasses best adapted are those that become completely dormant during the summer.

The brush or chaparral in California west of the Sierra crest can be arbitrarily separated into three associations because of differences in land utilization and management and because of relations between types of chaparral and land character. The three chaparral types are: the true chaparral (Fig. 1), the woodland-grass chaparral (Fig. 2), and the timberland chaparral (Fig. 3), characteristic of deforested or partially deforested timber sites.

Most of the area of true chaparral has been in brush as far back as the records go. Among the principal shrubs in this association are chamise (*Adenostoma fasciculatum*), scrub oak (*Quercus dumosa*), interior live oak (*Q. wislizenii*), manzanitas (*Arctostaphylos* spp.), buck brushes (*Ceanothus* spp.),

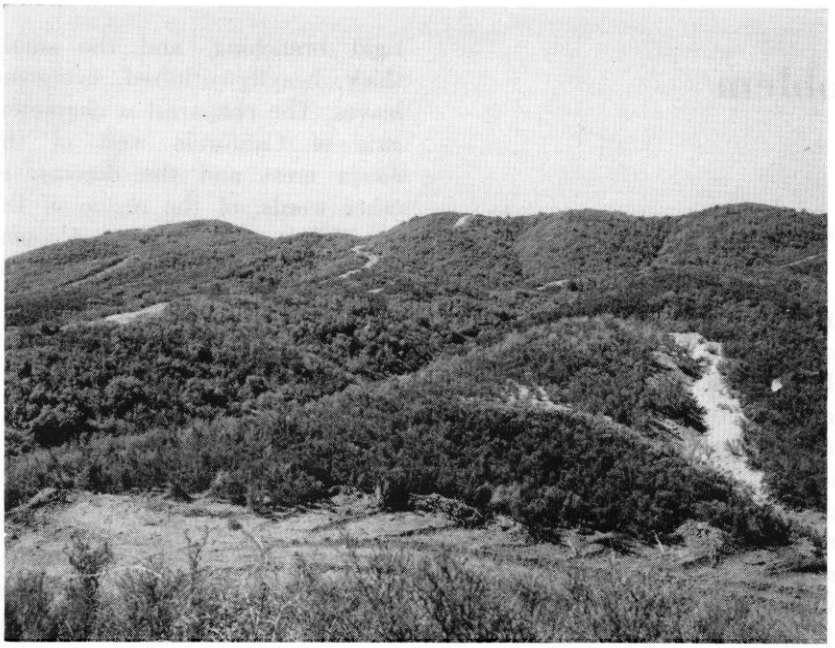

FIGURE 1. True chaparral in the north coast region of California. Principally chamise occurs on the southern slopes with oaks and other species on the northern exposures. Such areas are looked upon chiefly as valuable for game and watershed, although many areas in the North Coast Range are utilized by sheep.

toyon (*Photinia arbutifolia*), and chaparral pea (*Pickeringia montana*). Any of these may predominate in special sites. A majority of the species are sprouting. The brush canopy on most sites is so complete as to preclude much herbaceous vegetation as understory. The soils are usually shallow, although some of them are deep enough to be cleared for agricultural purposes. Some areas are not very steep but many are rugged and inaccessible and are not suitable for brush control work. True chaparral brushlands have been looked upon chiefly as valuable for game and watershed, although many areas in the north coast range are utilized to good advantage by sheep.

In the woodland-grass chaparral, some of the principal species are buck brushes, manzanitas and oaks. In this association a large percentage of the brush cover is made up of non-sprouting species. In most areas there is considerable herbaceous vegetation in the understory. The soils are fairly deep and productive. Brush invasion and increase have been marked in this type. The possibilities here are good for successful brush removal and manipulation. A majority of the woodland-grass areas are used primarily for domestic livestock production. Many of them have large numbers of deer and quail.

In timberland chaparral, manzanitas and buck brushes are common. The soil is chiefly suitable for timber production but due to logging, fire and other reasons the trees in many areas have been largely replaced by chaparral species. In many other places the trees are fairly abundant but the admixture of chaparral species creates a real problem in forest management. Once an area has been fully occupied by brush, forest reproduction comes back very slowly (Fowells and Schubert, 1951). Very little is known about the possibilities of brush removal and manipulation in this type.

The Wildfire Problem

One other thing that should be mentioned in connection with the hot summers and the very dry vegetation in the brush areas is that the fire hazard during the summer often becomes extremely high and wildfires are common. This important point must be considered in all phases of wildland management. For the years 1944–1951 an average of 424,000 acres burned annually by wildfires (American Forest Products compilation, 1945–1952). The magnitude of this problem is best indicated by a detailed study of fire occurrence made by the University of California and the California Forest and Range Experiment Station (Weeks *et al.*, 1943). On 3,210,000 acres in the northern Sierra Nevada foothills it was found that 3,565 fires burned 363,000 acres during the seven years 1932–1938, or 11 percent of the total.

The wildfires are started in almost every conceivable way. About one-fourth of them are started by lightning, and occasionally, a great number are set in a short time. During the summer of 1951, for example, it was reported that more than 800 lightning sets occurred in three days.

Wildland fires in California have grown into a multi-million dollar problem. State and Federal agencies are spending about $13,000,000 a year for protection, and damages from fire amounting to about $10,000,000 have been reported in recent years (Wyckoff, 1951). Considerable research has been done on fire behavior, the best way to control fires, and the damages they do. Greater emphasis in research is needed on methods of creating conditions which lessen the possibility that fires will occur and especially on how to create conditions in which the fires will do less damage.

Factors Governing Increase of Brush

Regenerative characteristics of brush plants important in governing succession include: the relative ability to increase by seed, the ability to spread by underground stems, and the ability to sprout from root crowns after destruction of tops by fire or cutting.

The nature of soils influences the character of brush successions. Usually, the light soils and those with shallow top soil and deep fractures in parent material are taken over first by brush. These soils have low water-holding capacity giving the deep-rooted woody species a definite advantage over the shallow-rooted grasses.

Brush successions have been studied in detail in the true chaparral and woodland-grass chaparral associations; studies in the timberland chaparral have been initiated recently. In the true chaparral, the plant cover has not changed greatly in the past 25 years or so. In some locations the true chaparral type has slightly extended its area; in other sites the boundaries of the type have retracted due to fire and browsing. In the area of the woodland-grass chaparral, the brush has increased in abundance rather generally in recent years. In the central Sierra Nevada foothills, both shrubs and trees were found to be increasing in abundance under all systems of grazing management, including total protection from grazing by domestic livestock. Careful investigations have led to the belief that a general increase in woody vegetation in this area is to be expected. With seed sources readily available, seedlings of woody plants may appear by the thousands each year. Fortunately, however, most of these seedlings die as a result of competition from grasses.

Several factors favor the tendency for brush to increase in abundance. Fires followed by protection which permits the new seedlings to mature and produce seed favor an increase in brush. After fires, brush seedlings almost always appear in great abundance. Fire seems to enhance germination of most species, probably by cracking the seed coat and enabling the seeds to imbibe water. More important, however, is the fact that burned areas of brush, in which the grass cover has already been weakened or choked out, form an ideal seedbed for seedlings. Sufficient moisture is present in summer to carry the brush seedlings through the dry period. A second outstanding factor favoring survival and establishment of brush seedlings is close grazing late in the green forage period. Close grazing destroys the capacity of herbaceous vegetation to deplete the soil of its moisture; consequently the shrubs are favored by moisture left in the soil. A third factor favoring brush seedling survival is the occurrence of heavy rains late in the season. After the grasses are largely dry, late rains may replenish the soil moisture favoring brush seedlings in summer.

On the other hand, several factors tend to retard the increase in woody vegetation. Among these,

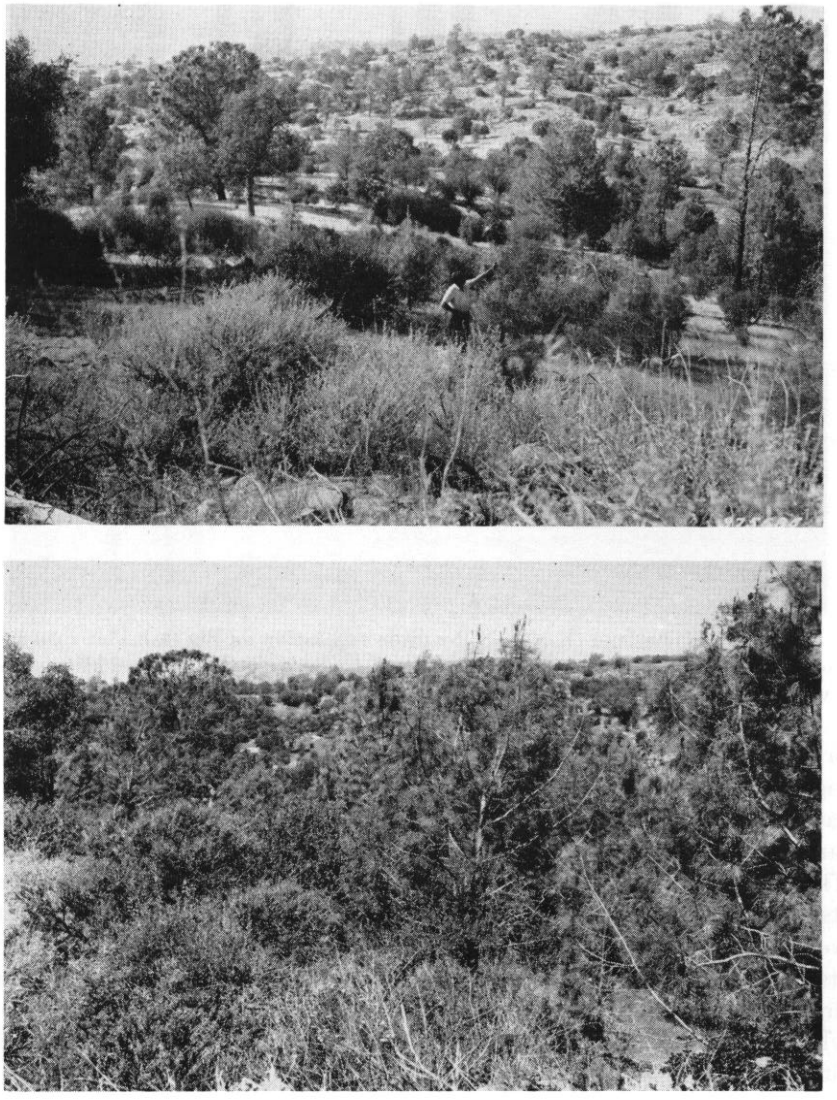

FIGURE 2. Area of woodland-grass in central Sierra Nevada foothills showing increase in brush. *Upper*. Taken in 1938. *Lower*. Taken in 1948.

FIGURE 3. Timberland chaparral. Roadside vegetation on Big Oak Flat road into Yosemite National Park. Brush interferes with timber reproduction and also creates a very high fire hazard.

probably the most important is a vigorous cover of herbaceous vegetation permitted to produce a large volume of forage at maturity. This cover so depletes the soil of its moisture that the seedlings of woody plants are unable to withstand the long period of summer drought. Any management practice which increases the vigor and density of herbaceous vegetation will help to retard brush increase.

The severity and frequency of fires may partially govern the tendency for an increase in woody vegetation. Should a fire be intense enough to kill all shrubs in a non-sprouting stand, and the same area is reburned in three or four years, the combination of two fires will greatly reduce the abundance of woody vegetation.

Browsing of deer is another factor which may retard woody vegetation. On small burns, the effect of localized browsing by deer may cause very great suppression of sprout regrowth. However, on large burns the browse may be so abundant that no appreciable removal is effected.

Browsing by domestic livestock may also retard the development of woody vegetation. Sheep are more effective in this respect than cattle because of the greater amount of browse taken. Livestock have been found to browse more during summer when the grasses are dry than during the spring when the forage is green. If domestic livestock are managed to retard brush, the plan should provide for light grazing or deferment until the grasses are dry, followed by grazing during summer.

Benefits from Brush Removal and Manipulation

The effects of brush removal and manipulation have been studied on wildlife populations. In true chaparral in the North Coast region, Taber (Biswell *et al.*, 1952) made comparisons in deer populations between areas which had been opened by brush manipulation and areas of dense natural brush. He found 40 to 110 deer per square mile in opened brush but only 10 to 30 per square mile in dense heavy brush. The proportion of fawns to deer was 115 to 140 per 100 does in opened brush, but only 60 to 85 fawns per 100 does were found in heavy brush. The bucks from opened brush were slightly heavier than those from dense heavy brush. In opened brush the deer fed largely on grasses and other herbs in February, March, April and

FIGURE 4. True chaparral opened by spot burning. Such areas in this condition are excellent for deer and also furnish browse for sheep.

May, while in the heavy brush the deer foraged almost entirely on shrubs.

Reseeding following removal of brush from areas of woodland-grass chaparral resulted in forage production of as much as 2000 pounds of air-dry forage per acre. Increase in forage production and grazing capacity for domestic livestock is closely related to the density of brush and the degree of removal. The effects of brush removal on the flow of springs are somewhat variable. Apparently, water yields are affected by such factors as the kind of vegetation removed, size of watershed and the depth of spring. In woodland-grass chaparral, the flow from a spring averaging 198 gallons per day increased to 486 gallons after the watershed of about 25 acres was burned clean by a controlled fire. On the other hand, the flow of another spring was not immediately affected by a clean burn on a watershed of 5 acres. In another instance, removal of a grapevine plant from a spring resulted in an increased flow of 15 gallons per day. Another spring accelerated from 31.5 gallons per day to 122 after a clump of willows, 35 feet in diameter, was removed from about the spring.

Although accurate measurement of fire hazard is difficult, evidence indicates that fire hazards may be reduced through brush control operations.

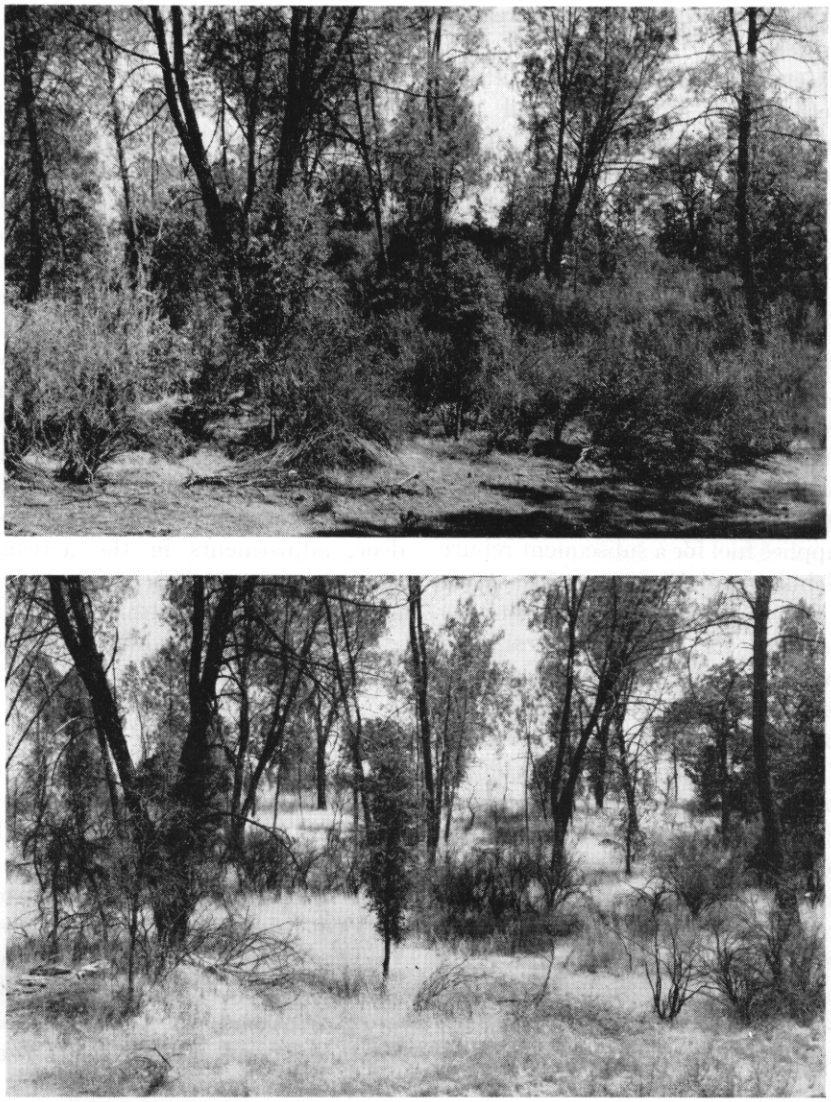

FIGURE 5. Woodland-grass chaparral in the central Sierra Nevada foothills. *Upper*. Before controlled burning. *Lower*. After controlled burning. This area was not reseeded.

Methods of Brush Removal

Several methods of brush removal have been studied, such as: controlled burning, bulldozing, application of chemical herbicides and combinations of these methods. Combinations of methods appear to be most effective.

Controlled burning has been widely used for brush removal. It is most effective in brush stands of non-sprouting species. An average of 67,000 acres of brush has been burned annually under State permit from 1945 to 1951, inclusive. In 1951 and 1952 about 133,000 acres were burned each year. In true chaparral, spot burning in early spring has been effective in creating conditions favorable for game (Fig. 4).

Where sheep are to graze burned areas, firing is usually done under fairly dry conditions. The resulting burn allows the sheep to move about freely.

Bulldozers are often used to break down brush so it will burn more readily and to facilitate complete removal. All or only portions of the brush on an area designated to be burned may be treated in this way. Bulldozers are also used to push out the brush and windrow it before burning. This is often done where the brush is all of the sprouting kind and in areas where fire is too risky. It should be done only in the less erosive soil types.

Chemical herbicides are often used alone to kill sprouting species or they may be used in combination with fire and mechanical means. In brush management for deer, chemical herbicides are often used to kill certain undesirable shrubs to

favor those that are more readily browsed.

Generally the most suitable method for brush removal will vary from area to area. Usually, however, a combination of methods proves most satisfactory.

Reseeding

Reseeding is an important phase of management following brush control in chaparral types. Reseeding provides forage for game and livestock, provides a plant cover beneficial in lessening soil erosion, furnishes competition to reduce survival of brush seedlings, and supplies fuel for a subsequent reburn (Schultz and Biswell, 1952). Areas of brush ash are prospective sites for seeding. In true chaparral, the entire area of cleared brush may be reseeded. In the woodland-grass chaparral, only a small percentage of the area cleared of brush might need reseeding in areas with enough grass in the understory of brush for natural reseeding (Fig. 5). A number of perennial grasses and annual grasses and legumes have been recommended as suitable for reseeding burned sites (Love and Jones, 1952). Fertilization is usually beneficial, especially where legumes are seeded, but as yet this has not been done on an extensive scale.

Grazing Management

The type of grazing management following removal of brush often governs the effectiveness of brush control. Any system of grazing that weakens the herbaceous cover also lessens grass competition and favors the invasion of brush. A system of grazing that maintains a strong herbaceous cover results in strong competition and retards invasion. The usual practice following brush removal is to defer grazing the first season until seed maturity, after which the forage is grazed to a moderate degree. Moderate grazing results in maximum competition between grass and brush and provides maximum seeding and establishment of grasses. In addition, browsing by livestock on brush seedlings and sprouts is an important factor in retarding the regrowth of brush.

Deferred grazing may not be desirable in true chaparral and in areas of interior live oak where browsing serves as the main controlling factor in brush suppression. In the manipulation of brush for deer, adjustments in the acreage burned may provide a desirable tool in regulating utilization, and in maintaining a vigorous cover of desirable shrubs for deer browse.

Summary

Many acres of wildlands in California have decreased in production as a result of invading brush or chaparral. The brush occurring west of the Sierra crest may be divided into three general types: (1) the true chaparral, (2) the woodland-grass chaparral, and (3) the timberland chaparral. In all of these types, the hazard from wildfires in summer is very great.

Increase in brush in many areas seems to be a natural phenomenon which is favored by occasional fires without reburning, close grazing that weakens the herbaceous cover, and rains late in the growing season after most of the grasses have dried. Factors that tend to retard the invasion of brush are moderate grazing, frequent burning and browsing by deer and livestock.

Benefits from brush removal and manipulation are an increase in forage production, an increase in wildlife populations and a decrease in fire hazard. Removal of brush has resulted in variable effects on the flow of springs.

Methods of brush removal include controlled burning, bulldozing and chemicals, application of herbicides and combinations of these. Usually a combination of methods works best. Other important and essential steps in brush removal are reseeding and grazing management.

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